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Innovative high-precision gravity prospecting technologies in petroleum geology and hydrocarbon exploration

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Abstract

This paper describes new opportunities offered by gravity prospecting for petroleum geology, presents the computer technologies developed by the author for the physical and geological characterisation of oil fields using high-precision gravity data and provides some oil and gas exploration case studies. The geological interpretation of the gravity field is often reduced to qualitative descriptions of low-accuracy transformed anomaly maps. The exploration recommendations that follow them are not usually justified by drilling. To make such research more effective, it is required to study density features, conduct dedicated gravity surveys and use efficient data interpretation techniques. Experimental rock gravity measurements made over many years have shown that the main anomalous mass sources in oil-bearing structures are vertical deconsolidated rock zones observed throughout sedimentary rocks. Such zones are observed as the largest gravity changes, an order of magnitude larger than those associated with density boundaries or oil or gas deposits. The gravity modelling technique developed by the author consists in the physical and geological modelling of exploration targets using direct gravity measurement data. Its 2D and 3D versions, in contrast to qualitative gravity anomaly interpretation techniques, provide quantitative analysis of geological structures in promising oil-bearing areas and deconsolidated zones. The resulting models can be of special interest in directional and horizontal drilling.

Keywords

Density, Gravity changes, Modeling, Oil fields